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CORE LIST

PONDEROSA PINE LUMBER RECOVERY -- Young Growth in Northern California

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Ponderosa Pine Lumber Recovery— Young Growth In Northern California

Reference Abstract

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1978. Ponderosa pine lumber recovery--young growth in northern California. USDA For. Serv. Res. Pap. PNW-237, 13 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Young-growth ponderosa pine logs from the Shasta-Trinity National Forest yielded 78 percent of volume in No. 3 and 4 Common grade lumber. Cubic recovery information and lumber grade recovery by log diameter classes are presented for the Grade 4 and 5 logs.

KEYWORDS: Lumber grading, lumber recovery, ponderosa pine, *Pinus ponderosa*, young growth, California (northern).

RESEARCH SUMMARY

Research Paper PNW-237

1978

Product yield information available to the forest products industry and timber managers must be periodically re-evaluated to reflect changes in grades, technology, and items produced. No. 3 Common lumber represented 55.4 percent of the product recovery from Grade 5 logs. This was more than double the volume of grade No. 3 Common lumber from old-growth logs.

Cubic recovery is discussed noting the recovery volume relationships between precise manufacture and both board feet lumber tally and cubic feet of lumber produced.

Resource utilization by processing stages is presented for the study log sample. Chippable residue volumes are shown by log size classes. Average cubic lumber recovery was 55 percent.

Introduction

Product yield information available to the forest products industry and timber managers must be periodically re-evaluated to reflect changes in lumber grades, processing technology, and the mix of lumber items produced. This report presents new information about lumber grade recovery and cubic volume relationships for unpruned young-growth ponderosa pine in northern California. It is based on a study designed to provide product yield that reflects some of these changes. The information is based on 170 ponderosa pine trees in the 60- to 80-year age class selected from the McCloud Ranger District of the Shasta-Trinity National Forest.

Approximately 10.0 MM board feet of ponderosa pine in all age classes are harvested annually from the McCloud District. Most of this volume is from trees above 18-inch diameter at breast height (d.b.h.).

There are several earlier recovery reports on ponderosa pine that are available for comparison to the results presented here (Gaines 1962, Matson 1955, Wise 1964, and Mueller and Kovner 1967).

The sample trees were selected by representatives of the Pacific Northwest Forest and Range Experiment Station; the

California Region, U.S. Forest Service; and a northern California forest products company. A selection of trees was made from a timber stand considered representative of the size and quality range of second-growth ponderosa pine currently being harvested in northern California. Individual trees were felled, bucked, and identified by tree and log number. This number identified the lumber items from each log throughout the sawing and planing phases of the study and was the basis for compilation and analysis of log and tree data. Bucked logs were scaled and graded according to U.S. Forest Service scaling handbook rules (USDA Forest Service 1973b). Table 1 summarizes log size and log scale information. Logs were sawn in 8- to 18-foot lengths with most logs being 16 feet long. The processing equipment at this cooperating mill included ring debarker, two band headsaws, edger, trimsaw, and resaw.

GRADE RECOVERY

Lumber grade recovery by log grade and diameter classes is presented in tables 2 and 3. The volumes of grades produced by board sizes are shown in table 4. The lumber items included 1,338 board feet of 4/4-inch Selects, Moulding, and Shop grades; 5,877 board feet of 5/4-inch items; and 68,389 board feet of 4/4-inch Common grades. These volumes are 1.8, 7.8, and 90.4 percent of the total volume, respectively.

Table 1--Summary of young-growth ponderosa pine log scale and cubic recovery values

Log grade ^{1/}	Number of logs	Scribner log scale		Scaled defect	Overrun (recovery) percent	Cubic recovery	Lumber tally	Lumber recovery factor ^{2/}
		Gross	Net					
		- Board feet -		- - - - -	Percent - - - - -		Board feet	
4	28	2,360	2,350	0	16	57	2,724	6.62
5	675	64,400	63,670	1	14	55	72,880	6.46
Total	703	66,760	66,020	1	15	55	75,604	6.46

^{1/} Improved grades for ponderosa pine and sugar pine.

^{2/} Board feet lumber tally per cubic foot of gross log volume.

Table 2--*Surfaced dry lumber grade recovery by log diameter classes for young-growth ponderosa pine Grade 4 logs*^{1/}

Log scaling diameter	Number of logs	Lumber tally	Lumber grades										Total		
			D and Better Select	Moulding and No. 3 Clear	Shop			Common							
					No. 1	No. 2	No. 3	Nos. 1 and 2	No. 3	No. 4	No. 5				
Inches		Board feet						Percent							
8	2	59	2/	--	--	--	--	--	--	--	37.29	49.16	8.47	5.08	100.00
9	1	23	--	--	--	--	--	--	--	--	30.43	21.74	47.83	--	100.00
10	6	382	--	--	--	--	--	--	--	--	12.04	53.41	29.84	4.71	100.00
11	2	197	--	--	--	--	--	--	--	--	45.69	42.64	10.15	1.52	100.00
12	6	466	.64	--	--	--	--	--	--	--	20.60	66.53	10.94	1.29	100.00
13	3	310	--	--	--	--	--	--	--	--	4.19	77.42	18.39	--	100.00
14	3	393	--	--	--	--	--	--	--	--	27.23	63.87	4.07	4.83	100.00
15	2	366	--	--	--	--	--	--	--	--	12.30	74.59	11.20	1.91	100.00
16	2	339	--	1.18	--	--	--	3.83	--	--	--	60.48	25.07	9.44	100.00
17	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
18	1	189	--	--	3.70	--	--	--	--	--	25.40	57.67	13.23	--	100.00
Average or total	28	2,724	.11	.15	.25	--	--	.48	--	--	17.40	62.78	15.60	3.23	100.00

^{1/} Percentages are actual values uncurved.^{2/} -- = No recovery in these lumber grades and diameter classes.

Table 3--Surfaced dry lumber grade recovery by log diameter classes for young-growth ponderosa pine Grade 5 logs^{1/}

Log scaling diameter	Number of logs	Lumber tally	Lumber grades										Total		
			D and Better Select	Moulding and No. 3 Clear	Shop			Common							
					No. 1	No. 2	No. 3	Nos. 1 and 2	No. 3	No. 4	No. 5				
Inches		Board feet						Percent							
5	21	328	-- ^{2/}	--	--	--	--	--	14.33	58.53	19.21	7.93		100.00	
6	60	1,155	.52	--	--	--	--	--	9.35	57.92	23.29	8.92		100.00	
7	47	1,256	--	--	--	--	--	--	13.85	53.75	25.08	7.32		100.00	
8	63	1,868	--	.21	--	--	--	--	11.83	61.73	20.45	5.78		100.00	
9	58	2,448	.16	.37	--	--	--	--	11.19	62.75	21.24	4.29		100.00	
10	48	3,075	.16	--	--	--	--	.10	9.63	61.04	25.69	3.38		100.00	
11	45	3,430	.20	--	--	--	--	.50	9.65	64.37	21.81	3.47		100.00	
12	51	4,763	.25	--	--	--	--	.17	13.00	66.32	16.42	3.84		100.00	
13	46	5,247	.27	--	--	--	--	.51	12.29	64.42	18.20	4.31		100.00	
14	41	5,292	.24	.19	--	--	--	.19	14.47	64.39	17.88	2.00		100.00	
15	42	6,614	.26	.05	.15	.49	.38	.20	12.99	61.85	21.83	2.15		100.00	
16	31	5,240	.27	.60	--	--	.86	1.51	13.49	62.38	18.87	2.02		100.00	
17	30	6,253	.05	.66	.46	1.49	1.26	1.26	13.34	59.07	20.66	3.01		100.00	
18	19	4,373	.37	1.89	.30	4.99	1.83	1.83	11.73	56.61	19.99	2.29		100.00	
19	21	5,091	.14	.92	2.34	3.34	4.58	4.58	2.06	45.27	37.30	4.05		100.00	
20	20	5,271	.34	1.20	4.14	7.70	5.07	5.07	5.56	43.87	30.51	1.61		100.00	
21	13	3,974	.28	.38	4.13	19.10	9.01	9.01	3.12	43.22	19.78	.98		100.00	
22	4	1,236	--	.65	1.62	20.63	10.11	10.11	1.54	42.31	20.55	2.59		100.00	
23	4	1,433	--	.42	1.33	21.63	9.98	9.98	2.51	30.07	29.24	4.82		100.00	
24	4	1,614	--	.50	2.42	41.13	9.11	9.11	5.58	30.66	9.67	.93		100.00	
25	3	1,276	.39	1.96	.39	37.30	10.27	10.27	--	32.13	16.07	1.49		100.00	
26	1	439	--	2.51	--	48.97	8.43	8.43	6.83	31.44	1.14	.68		100.00	
27	2	772	--	--	.65	40.02	11.27	11.27	6.48	29.40	12.18	--		100.00	
28	1	432	1.16	.93	1.62	36.57	5.09	5.09	3.24	31.25	14.12	6.02		100.00	
Average or total	675	72,880	.22	.50	.91	5.67	2.56	2.56	9.82	55.54	21.76	3.02		100.00	

^{1/} Percentages are actual values uncurved.

^{2/} -- = No recovery in these lumber grades and diameter classes.

Table 4--Young-growth ponderosa pine lumber grade recovery by lumber item size for all study logs

Lumber size	Lumber grades ^{1/}									
	Select			Factory lumber			Common			
	B and Better	C	D	Moulding	No. 3 Clear	Nos. 1, 2, and 3 Shop	Nos. 1 and 2	No. 3	No. 4	No. 5
Inches	Board feet									
4/4 ^{2/}	-- ^{3/}	--	--	4	73	870	--	13	123	--
5/4 ^{2/}	--	--	13	51	--	5,810	--	--	3	--
1 x 4	6	21	81	42	--	--	715	2,826	1,550	763
1 x 6	--	5	34	41	30	--	660	5,366	2,468	322
1 x 8	--	--	--	11	--	--	810	7,109	3,391	357
1 x 10	--	--	--	--	--	--	1,224	6,754	2,648	344
1 x 12	--	--	--	--	120	--	4,220	20,124	6,098	504
Total	6	26	128	149	223	6,680	7,629	42,192	16,281	2,290

^{1/} Surface dry, graded under supervision of Western Wood Products Association lumber inspector.

^{2/} Mixed board widths.

^{3/} -- = No recovery in these lumber grades and size classes.

No. 3 Common was the largest lumber grade volume recovered. It represented 62.8 percent of the No. 4 Grade logs and 55.4 percent of the No. 5 grade logs. When both log grades are combined, recovery was 55.8 percent. In contrast, the recovery of this lumber grade from Grade 5 old-growth ponderosa pine logs was reported by Wise (1964) as 22 percent. That comparison is based on a similar range of log diameters for both studies. Yield differences such as these show the influence of changes in resource characteristics.

The No. 3 Common lumber accounted for 54.9 percent of the total lumber value from Grade 5 logs. Ponderosa pine is often considered for Shop grade lumber items. The Grade 5 logs in this young-growth timber yielded only 9.64 percent Shop and Moulding grades of lumber (table 3). Based on the lumber prices used in figure 3 calculations, this volume, however, represents 12.04 percent of

the total lumber value from Grade 5 logs.

Log size and grade both have an influence on lumber grade recovery. Table 3 of uncurved grade recovery percentages shows this relationship for Grade 5 logs. Figure 1 for No. 3 Common lumber from Grade 5 logs further shows this relationship. The regression is based on log diameter class averages.

THE LUMBER RECOVERY RATIO (LRR)

Accurate sawing of green lumber to provide for sawing variation, shrinkage, and minimum planing allowance will improve the recovery percentages that are usually expressed as overrun. Figure 2 shows the relationship of overrun to sawn log diameter for these 703 logs. The low R^2 value of 8.1 indicates a high degree of variation around the regression. Analysis of covariance showed no significant difference in slope or intercept between

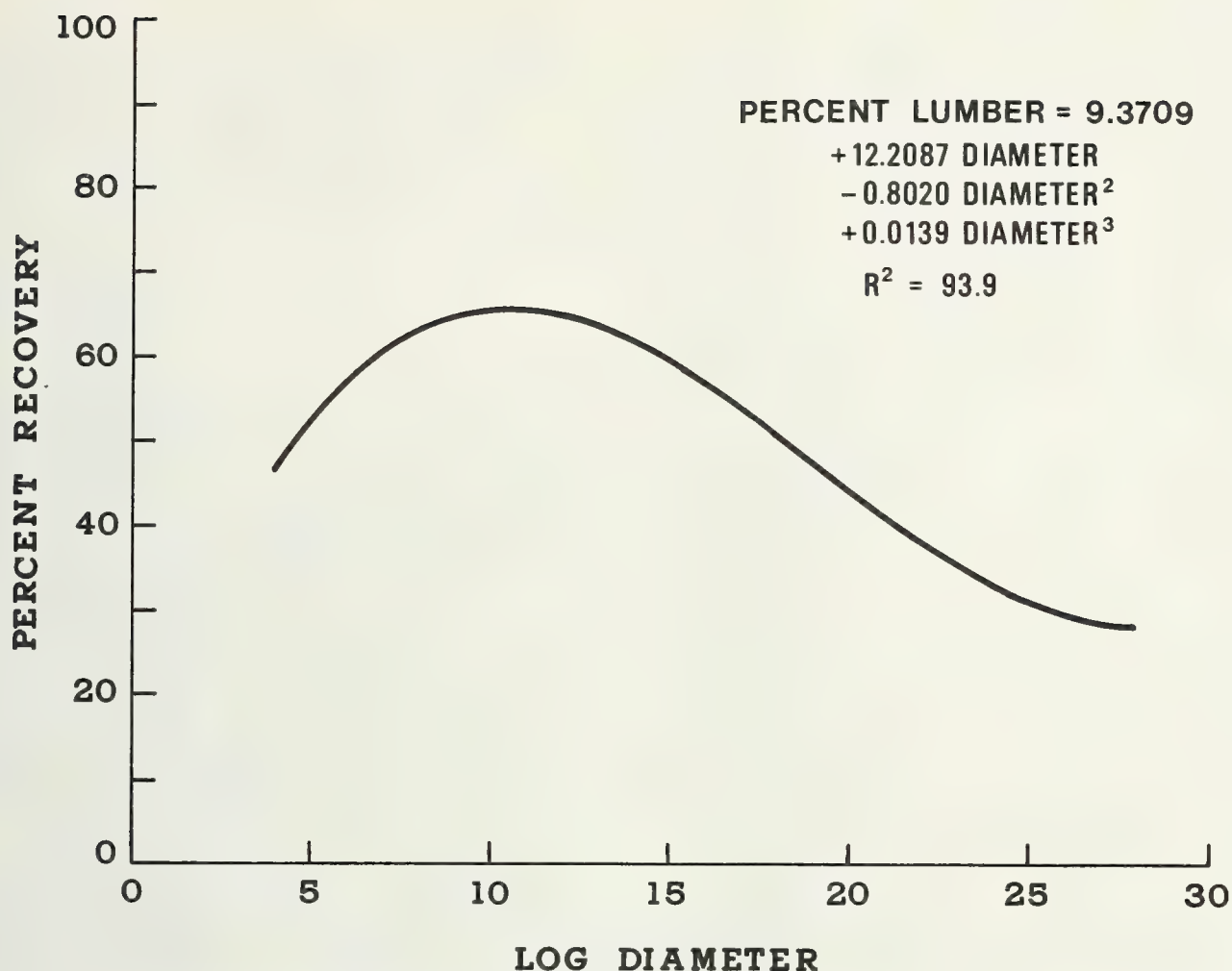


Figure 1.--No. 3 Common lumber as a percentage of total surfaced dry lumber by diameter class averages for Grade 5 logs.

Grade 4 and 5 logs; therefore, the common regression line is shown.

The reader is undoubtedly aware of the relationship of overrun to log diameter. This oddity of log measurement says that the estimate made as to what a log will produce in lumber--is not what gets produced. Any difference, higher or lower, is termed overrun or under-run as the case may be.

Plotted overrun data for the 703 sample logs emphasizes the variation in recovery and overrun from small sound logs. Scribner scale approaches zero overrun for logs in the 20- to 25-inch diameter classes. Estimates of lumber recovery for small diameter logs should be strongly

tempered based on known overrun variability. This is especially evident for logs below 15 inches in diameter as shown in figure 2.

Some measurement of mill equipment efficiency and production is a necessary tool to the mill manager. Several reports have become available recently that present lumber recovery factors (LRF) and lumber recovery ratios (LRR) as production efficiency measurement tools (Dobie 1975, Fahey and Martin 1974, Fahey and Woodfin 1976, and Pong and Fahey 1973). An LRF of 6.46 was measured for this study based on surfaced dry lumber tally and log gross cubic volume (i.e., 6.46 board feet of lumber recovery on the average from every cubic foot of log input to the sawmill). The average

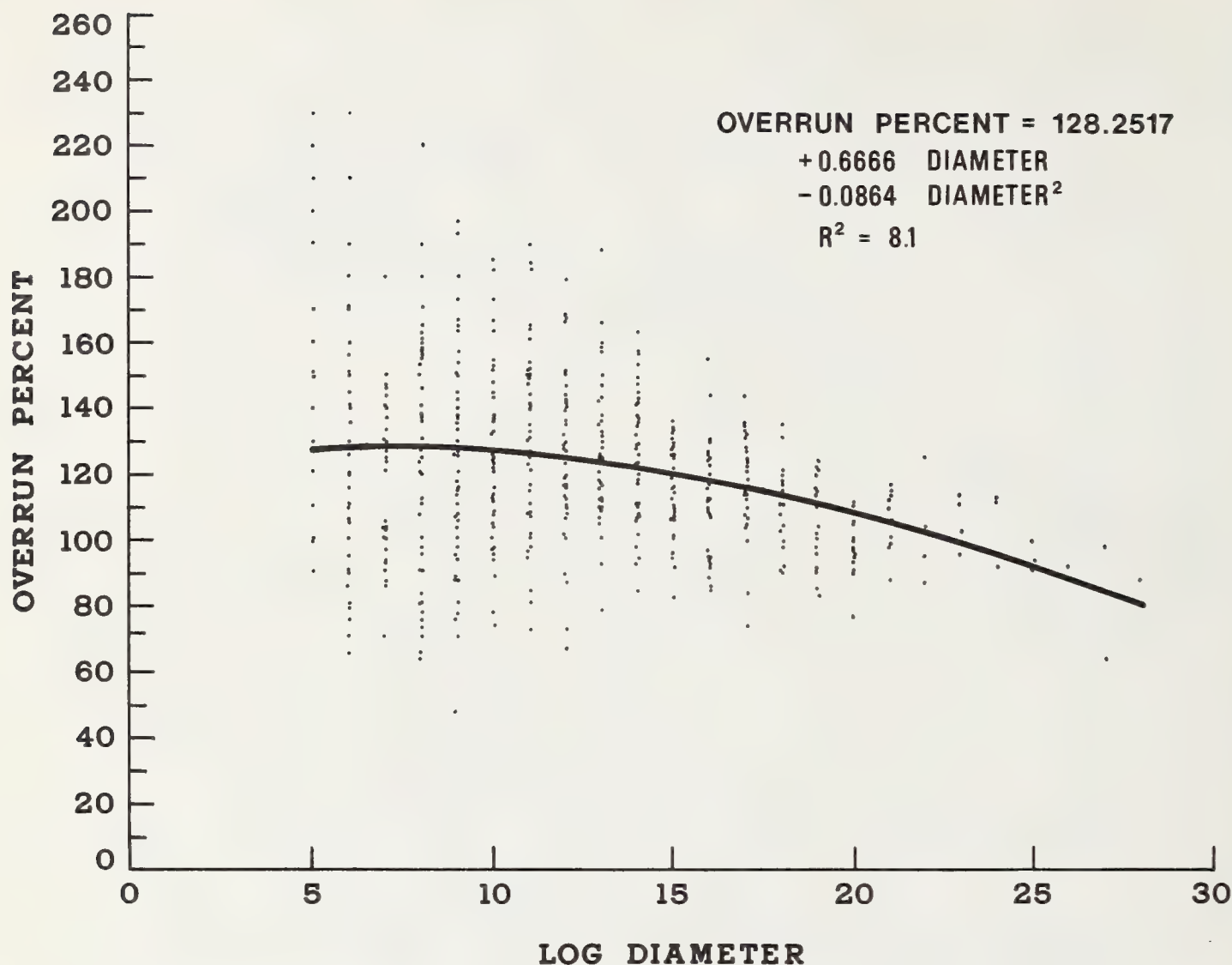


Figure 2.--Overrun curve for combined log Grades 4 and 5--703 young-growth ponderosa pine logs.

LRF for all sawmills in the United States has been estimated at 6.5 board feet (USDA Forest Service 1973a). The gross cubic volume was computed by the following formula:

$$\text{Volume} = \frac{\pi L (D_1^2 + D_1 D_2 + D_2^2)}{12 \times 144};$$

where, π is the constant pi,
 D_1 is average log diameter, large end,
 D_2 is average log scale diameter, small end, and
 L is log scaling length.

By definition 12 board feet of nominal 1-inch lumber is equivalent to 1 cubic foot of lumber. One cubic foot of surfaced dry 4/4-inch lumber, however, is approximately 15 actual board feet per cubic foot of lumber (25/32-inch surfaced board thickness = 0.78 inch and $12 \div 0.78 = 15.38$). The average rough green thickness of lumber produced during this study was 32/32, a full inch. This resulted in 12.0 board feet lumber tally per cubic foot of lumber produced. For other studies we have conducted, these values have ranged from 11.69 to 13.95 board feet per cubic foot. A reduction of 1/32 inch in the rough green thickness for 1-inch lumber should theoretically increase actual

lumber recovery about 3 percent. For example, assuming full recovery of this 3 percent by accurate manufacturing, the increase would mean an additional 2,092 board feet of recovery in this study (103 percent x 69,727 = 71,819 board feet). Based on a \$195/MBF lumber price, this extra volume is valued at nearly \$408.00.

Changes in processing technology are reflected in Mueller and Kovner (1967) and Wise (1964). The average rough green 1-inch lumber sizes for those two studies were 34/32 to 35/32 and 35/32 respectively. Over 9 percent less wood (3/32) was required in cutting a 1-inch board from this study with the average lumber size of 32/32. In terms of lumber recovery, this means about 1 board foot more of lumber for each cubic foot of rough green lumber produced.

The 4/4-inch lumber accounted for 92.2 percent of the total lumber produced with the balance being 5/4-inch. If the LRR is recalculated to include a 3-percent increase in the volume of 4/4-inch lumber, lumber recovery ratio would increase from 55 to 57 percent. Such a potential increase in recovery from high valued logs is of concern to mill managers. Product grade yield and cubic recovery relationships as reported here can provide the basis for these evaluations.

LOG AND TREE VALUE—CUBIC VOLUME

Average value of sawn logs in this study can be expressed in several terms. We are most familiar with log values expressed as dollars per thousand board feet lumber tally (\$/MLT) or as dollars per thousand board feet net Scribner log scale (\$/MNS). Log grade values are shown in the following tabulation. A new term is included, dollars per hundred cubic feet of gross log volume sawn (\$/100CFGL).

<u>Value</u>	<u>Log Grade 4</u>	<u>Log Grade 5</u>	<u>Trees</u>
\$/MLT	\$182.54	\$180.80	\$180.86
\$/MNS	211.60	206.96	207.12
\$/100CFGL	120.92	116.76	116.91

Figure 3 shows the relationship of \$/100 cubic feet to tree d.b.h. for this study. The calendar year 1973 U.S. Forest Service, California Region lumber prices were used:

<u>Lumber Grade</u>	<u>Price/MLT</u>
B and Better Select	\$501.57
C Select	493.39
D Select	373.06
Moulding	362.42
No. 3 Clear	293.28
No. 1 Shop	262.58
No. 2 Shop	226.29
No. 3 Shop	192.83
1 and 2 Common	238.18
3 Common	178.86
4 Common	150.13
5 Common	91.76

Study results can be illustrated graphically to show resource utilization by processing stages. When displayed as in figure 4, it is easier to appreciate the use of \$/100 cubic feet as an expression of value recovered.

Figure 5 illustrates the percent of gross log volume that was produced as rough green lumber. As noted earlier, there was no significant difference between the Grade 4 and Grade 5 log recovery values. Therefore a common regression could be used. Both curves are shown, however, because the grades are considered separately in timber valuation and lumber grade yields.

RECOVERY BY TREES

The first 16-foot log of every tree was Grade 5 log by Improved Ponderosa Pine Log Grading System (Gaines 1962). Only 28 of the 703

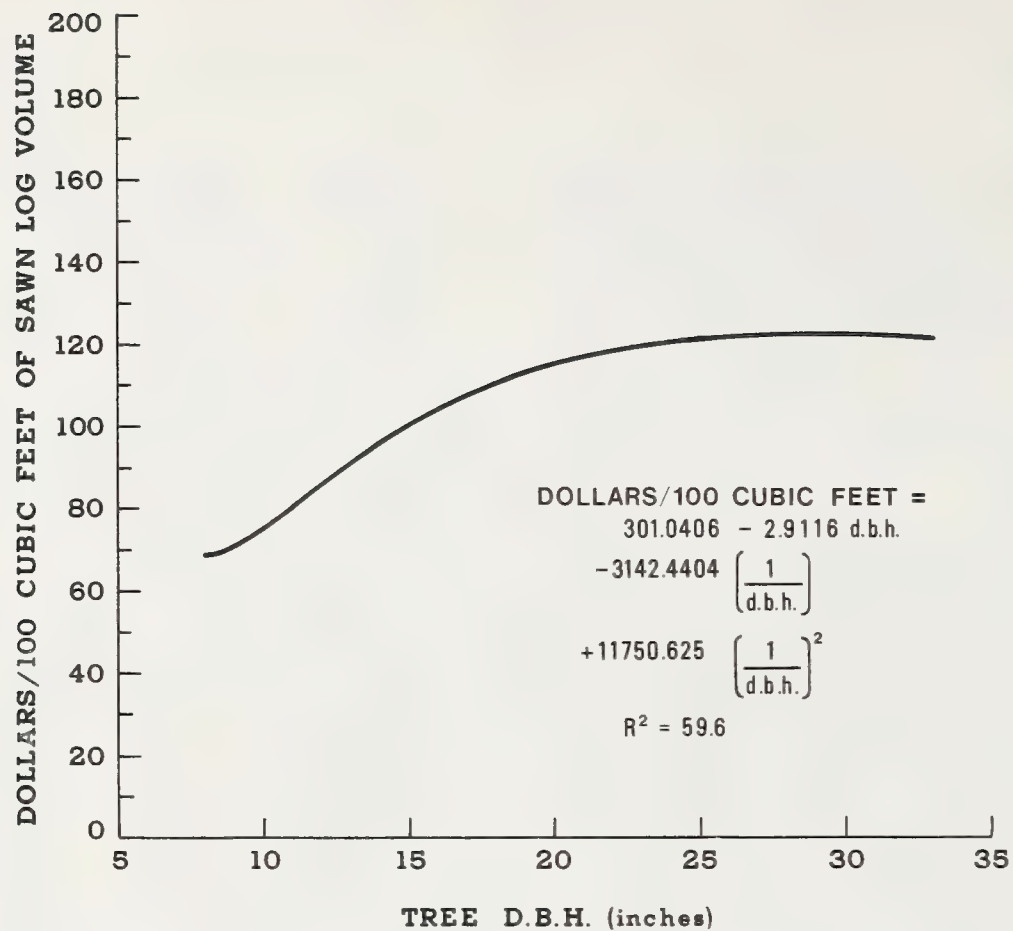


Figure 3.--Young-growth ponderosa pine--tree gross realization in dollars per 100 cubic feet of sawn log volume by d.b.h. classes.

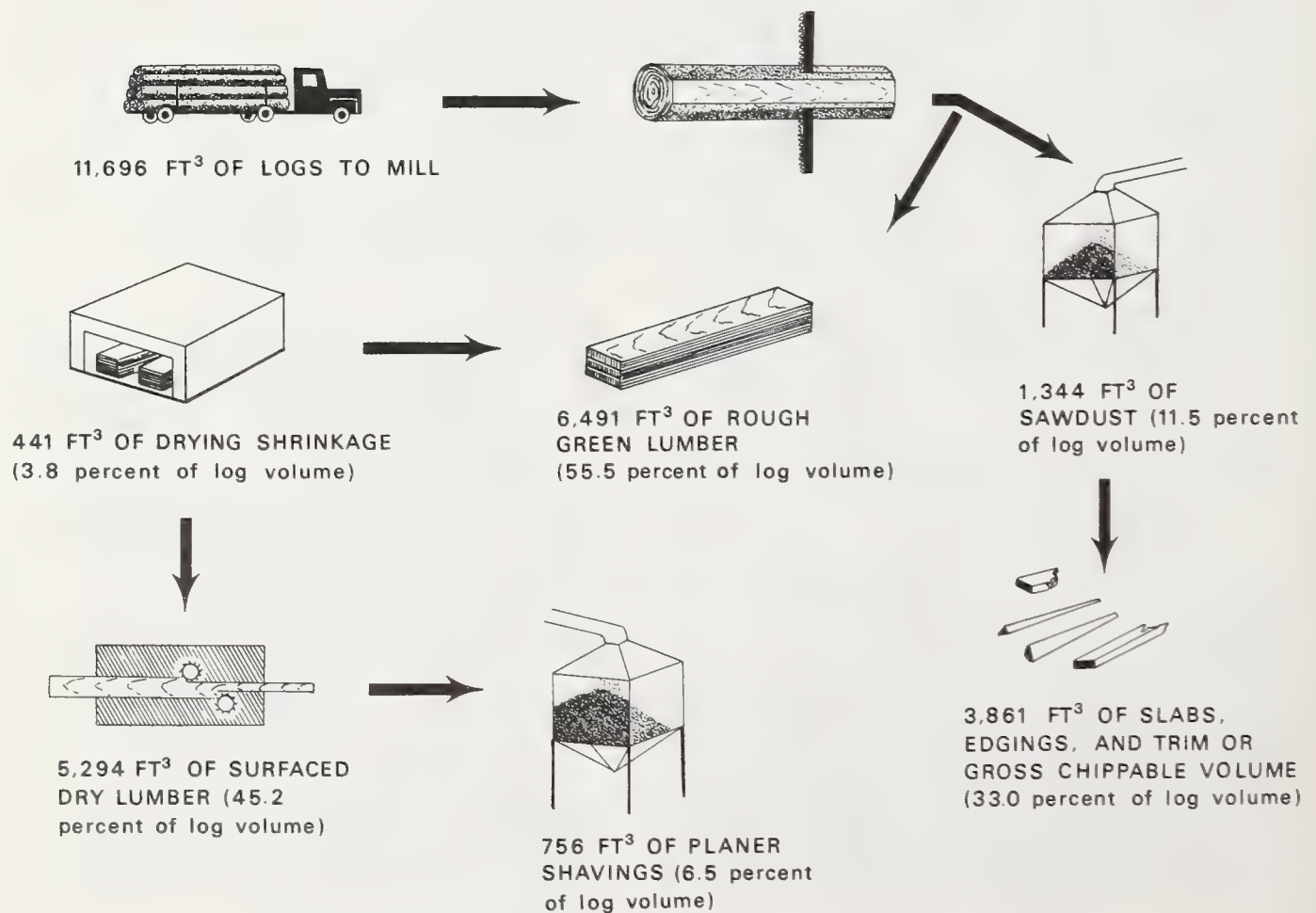


Figure 4.--Where cubic volume goes during lumber production.

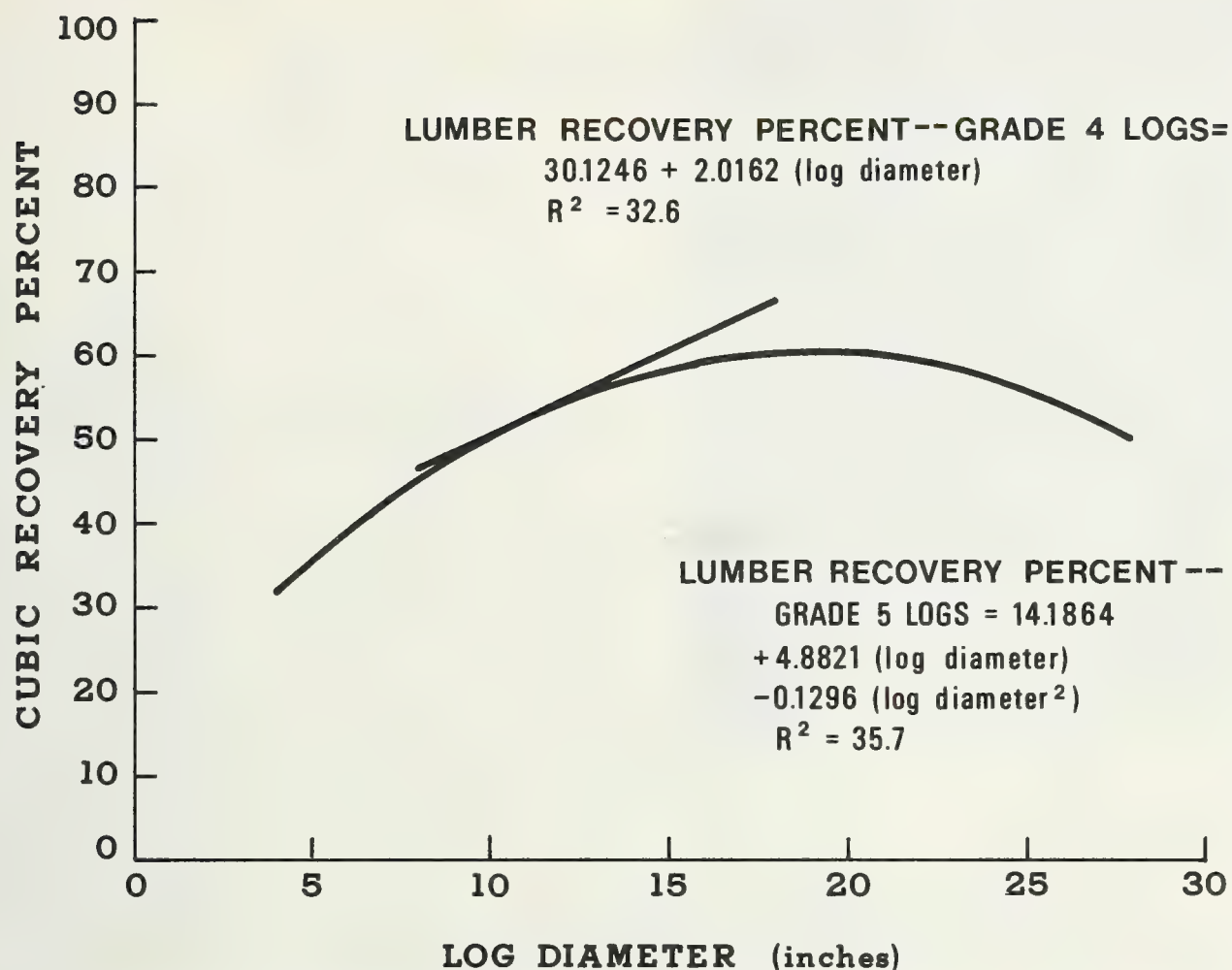


Figure 5.--Percent of gross log volume produced as rough green lumber by log diameter--Grade 4 and 5 ponderosa pine.

logs cut from these were Grade 4, the remainder were Grade 5 (fig. 6).

Regressions of cubic recovery percentage for rough green lumber and sawdust are presented in figure 7. The curves have been plotted in cumulative fashion in order to easily estimate volumes by tree diameter. For example, as read from figure 7, a 20-inch d.b.h. tree yielded the following estimated product amounts from the utilized portion that was delivered to the mill: 7.8 percent sawdust, 54.7 percent rough green lumber (62.5 - 7.8), and 37.5 percent available for chips (100.0 - 62.5).

Table 5 shows the distribution of lumber grade recovery percentages

by tree diameter. The reader is reminded that the number of sample trees in the larger diameters is limited; therefore, the recovery values from prediction equations in this range should be viewed with caution for their accuracy.

The variation in cubic recovery due to log and tree sizes is illustrated by the rough green lumber curve in figure 7. Cubic recovery averaged 55 percent for all logs but ranged from 39 percent for 5-inch logs to 63 percent for 18-inch logs. These relationships should be of concern to any forest products industry installation heavily involved in utilization of small timber. The cubic recovery percentage for all logs is shown in figure 5.



Figure 6.--Representative ponderosa pine in tree sample area. Limbiness was characteristic of stand.

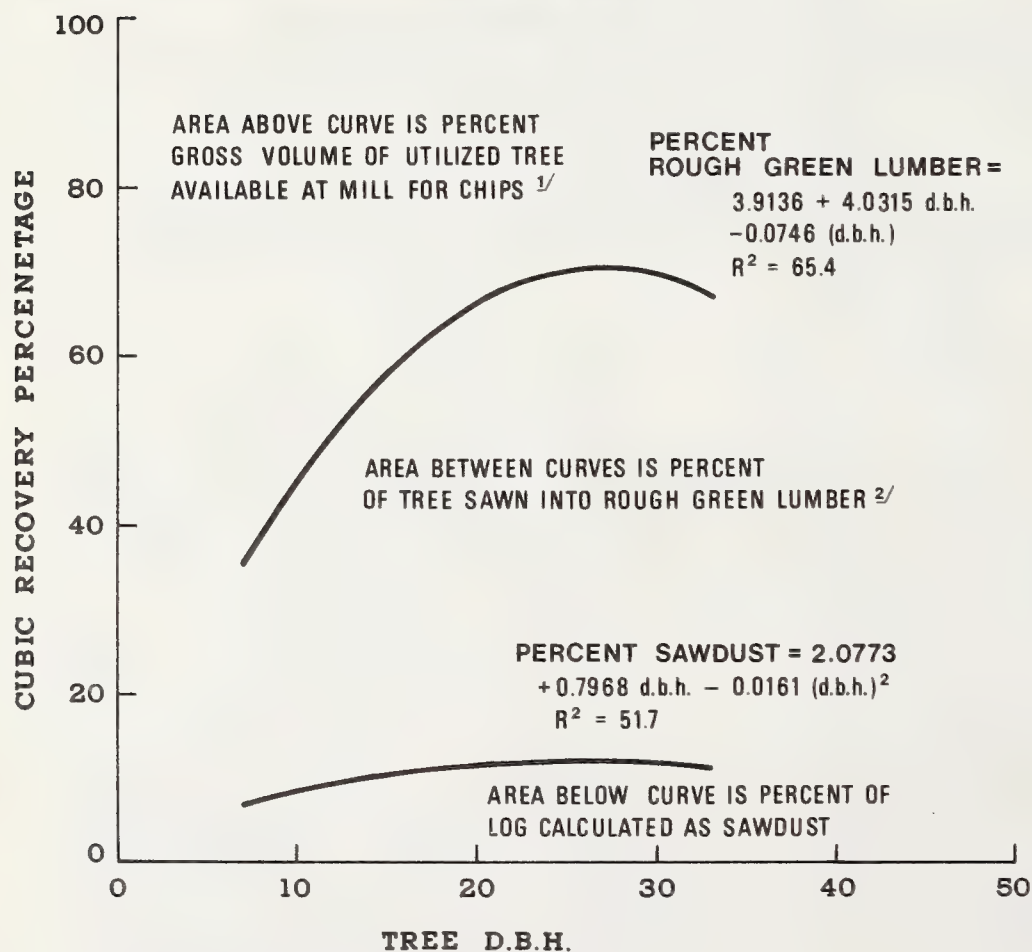


Figure 7.--Percent of utilized tree cubic volume recovered as rough green lumber, produced into sawdust, and available for chipping.

^{1/} DOES NOT DOES NOT INCLUDE TREE TOP OR LONG BUTTS LEFT IN WOODS.

^{2/} AVERAGE THICKNESS 32/32 INCH.

^{3/} THIS IS CUMULATIVE SET OF CURVES WITH VALUES OF THE UPPER CURVE READ FROM THE LOWER ONE AND NOT FROM THE TREE D.B.H. AXIS.

Table 5--Surfaced dry lumber grade recovery by tree diameter classes for young-growth ponderosa pine^{1/}

D.b.h.	Number of trees	Lumber tally	Lumber grades								Total	
			D and Better Select	Moulding and No. 3 Clear	Shop			Common				
					No. 1	No. 2	No. 3	Nos. 1 and 2	No. 3	No. 4		No. 5
Inches	Board feet		Percent									
8	4	66	2/	--	--	--	--	7.58	69.69	18.18	4.55	100.00
9	3	79	--	5.06	--	--	--	6.33	58.23	24.05	6.33	100.00
10	8	325	--	--	--	--	--	18.15	49.54	21.23	11.08	100.00
11	12	670	--	.75	--	--	--	18.06	50.30	25.07	5.82	100.00
12	8	537	--	--	--	--	--	15.83	55.87	23.09	5.21	100.00
13	5	687	.58	.58	--	--	--	7.42	53.72	31.30	6.40	100.00
14	6	847	--	--	--	--	--	17.00	61.16	17.47	4.37	100.00
15	13	2,388	--	--	--	--	--	9.92	63.07	25.00	2.01	100.00
16	8	1,872	.27	--	--	--	.59	10.20	60.95	24.20	3.79	100.00
17	7	1,853	.16	--	--	--	--	14.03	65.68	17.32	2.81	100.00
18	10	3,163	.22	--	--	--	--	9.42	63.99	22.86	3.51	100.00
19	5	2,087	.38	--	--	--	1.92	10.21	62.67	20.70	4.12	100.00
20	10	4,710	.70	.13	.17	.28	--	15.69	64.20	15.94	2.89	100.00
21	9	4,568	.07	.07	.11	.20	.33	10.99	64.02	22.02	2.19	100.00
22	6	3,067	.33	--	.26	.42	.33	11.44	64.23	19.24	3.75	100.00
23	6	4,120	.10	.78	1.17	1.26	1.50	9.05	56.91	27.26	1.97	100.00
24	14	9,632	.16	.42	.35	1.10	1.37	12.19	58.85	21.97	3.59	100.00
25	3	2,242	.13	.45	--	1.47	1.34	10.35	59.01	22.48	4.77	100.00
26	8	6,135	.29	.80	3.52	1.47	.83	14.20	54.95	21.22	2.72	100.00
27	7	5,737	.16	.16	2.81	6.80	4.17	4.65	51.49	27.58	2.18	100.00
28	5	4,055	.29	1.97	1.53	4.64	3.13	9.69	48.91	27.42	2.42	100.00
29	2	1,961	.15	2.39	1.48	9.74	1.68	13.16	52.63	16.78	1.99	100.00
30	3	3,686	.08	.38	.68	13.84	10.96	2.50	49.58	17.88	4.10	100.00
31	4	4,913	.08	.49	.73	19.19	4.76	2.95	45.63	23.65	2.52	100.00
32	3	4,969	.20	.62	.50	23.65	8.63	10.44	41.62	11.99	2.35	100.00
33	1	1,235	.40	1.13	1.21	33.69	5.02	3.56	39.45	13.60	1.94	100.00
Average or total	170	75,604	.21	.49	.89	5.46	2.49	10.09	55.81	21.53	3.03	100.00

^{1/} Percentages are actual values uncurved.

^{2/} -- = No recovery in these lumber grades and diameter classes.

Summary

Young-growth ponderosa pine yielded about 56 percent of the lumber recovery volume in grade No. 3 Common lumber and 25 percent in grades Nos. 4 and 5 Common lumber combined. An average of 55.5 percent of the log volume was recovered as rough green lumber, 11.5 percent went to sawdust,

and 33.0 percent was available for chipping. Lumber recovery factor (LRF) was 6.46 board feet of surfaced dry lumber recovery per cubic foot of log input. The lumber recovery ratio (LRR) was 0.55 cubic feet of rough green lumber per cubic foot of log volume.

Summary of Log Grade Specifications Defects Permitted

<u>Grade</u>	<u>Primary (log knots)</u>	<u>Secondary (scars, etc.)</u>
1	One log knot not over one-half-inch diameter	Confined to three panels or less
2	Confined to four panels or less	Secondary plus primary confined to six panels
3	Six panels free of all grading defects	
4	(a) 80 percent bark limbs (b) Bark limbs not exceeding one-sixth log diameter. Other log knots not exceeding one-twelfth log diameter (c) Not more than 24 limbs near maximum size	Confined to 3 panels or less
5	All other logs, if net scale one-third or more of gross	

General Specifications (Gaines 1962) and Definitions

1. Apply to 16-foot logs as cruised.
2. Must be live logs with one-third net scale.
3. Grading defects apply without reference to scaling practice.
4. Grading defects are log-surface abnormalities that influence quality of lumber sawn from log.
5. Primary defects are "log-knots", limbs, stubs, limb holes, overgrown knots.
6. Secondary defects are scars, large or unsound burls, forks, crooks, cracks, cankers.
7. Log knots within scars are disregarded if 2 in. or smaller and 5 in. or more below normal wood surface; otherwise they are counted.
8. False defects (disregard) are small sound burls, bumps, flutes or flanges, bird peck, minor bark distortions.
9. Indeterminate defects (disregard) are sweep, spiral, grain.
10. A panel is one-fourth circumference, 4 feet long. May be scattered over log but must not overlap.
11. Primary defect takes precedence over secondary on any panel.

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KEYWORDS: Lumber grading, lumber recovery, ponderosa pine,
Pinus ponderosa, young growth, California (northern).

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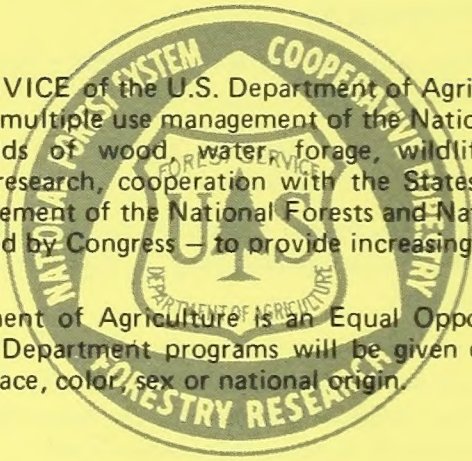
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1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

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